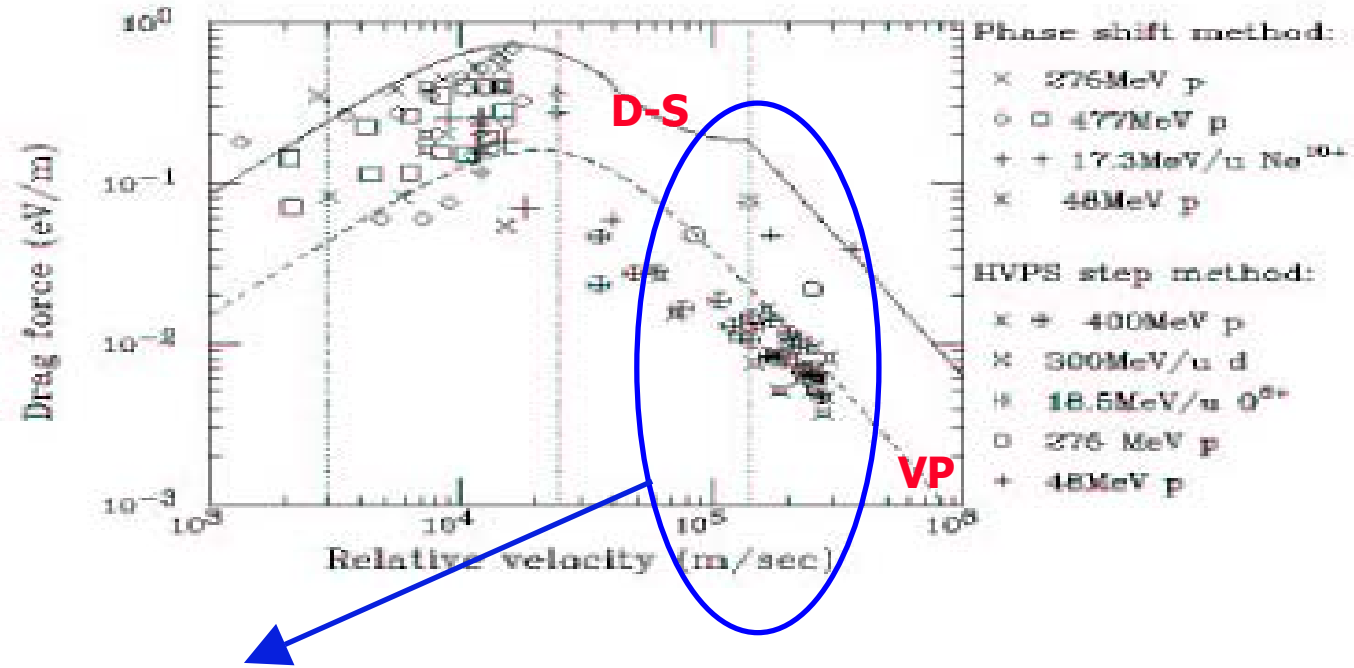
Comparison of D-S vs VP formulas in experiments (Longitudinal friction force)

Y-N. Rao et al.: CELSIUS, Sweden'2001:



Longitudinal: D-S overestimates cooling force by factor of 10. VP agrees reasonably well.

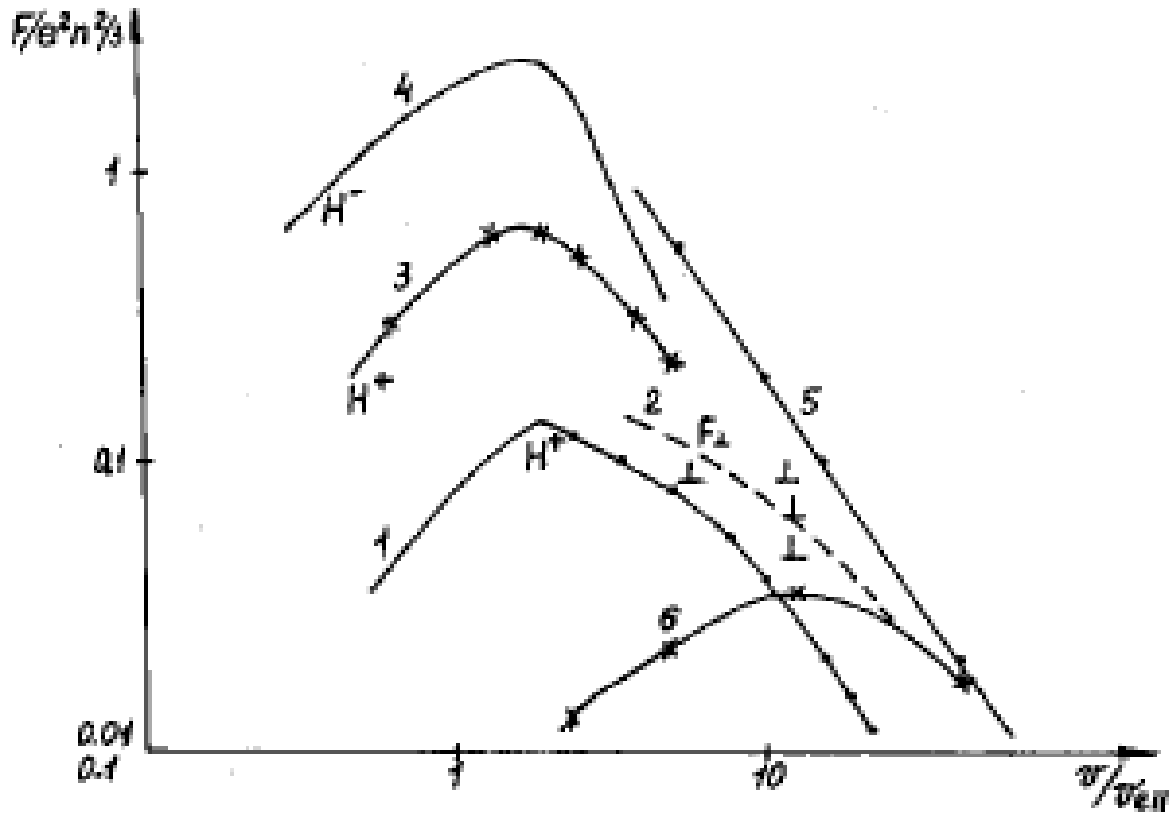
Comparison of D-S vs VP in experiments (Transverse cooling force)

the measurements and calculations".

Ion	Energy [MeV/u]	Hori. emit. [$\pi\mu$m]	E beam Current [mA]	e^{-1} cooling time [sec]					
				Measure-ments	VVP's formula [b]	"Standard" formula [c]		Meshkov's formula [d]	
P	400	0.9	100	7.7	13.7	8.8	22.4	2.4	3.3
		0.9	250	3.6	6.1	3.5	8.9	0.9	1.4
		2.0	390	3.1	11.9	6.0	11.2	2.0	1.6
		1.5	350	6.8	8.9	4.3	9.6	1.4	1.9
		1.5	600	4.4	5.5	2.5	5.6	0.8	1.2
		1.5	830	3.8	4.2	1.8	4.0	0.6	0.9
d^{1+}	181	1.0	50	8.0	9.6	18.9	31.1	1.6	2.3
		1.0	100	4.5	5.9	9.4	16.2	0.9	1.3
$^{14}N^{7+}$	300	0.134	100	2.8	0.23	2.0	2.3	0.019	- [e]

Transverse: D-S overestimates cooling time by a factor 2-3. VP underestimates it by about factor of 2.

NAP-M and MOSOL measurements
Novosibirsk 70's and 80's



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Schematic of friction force

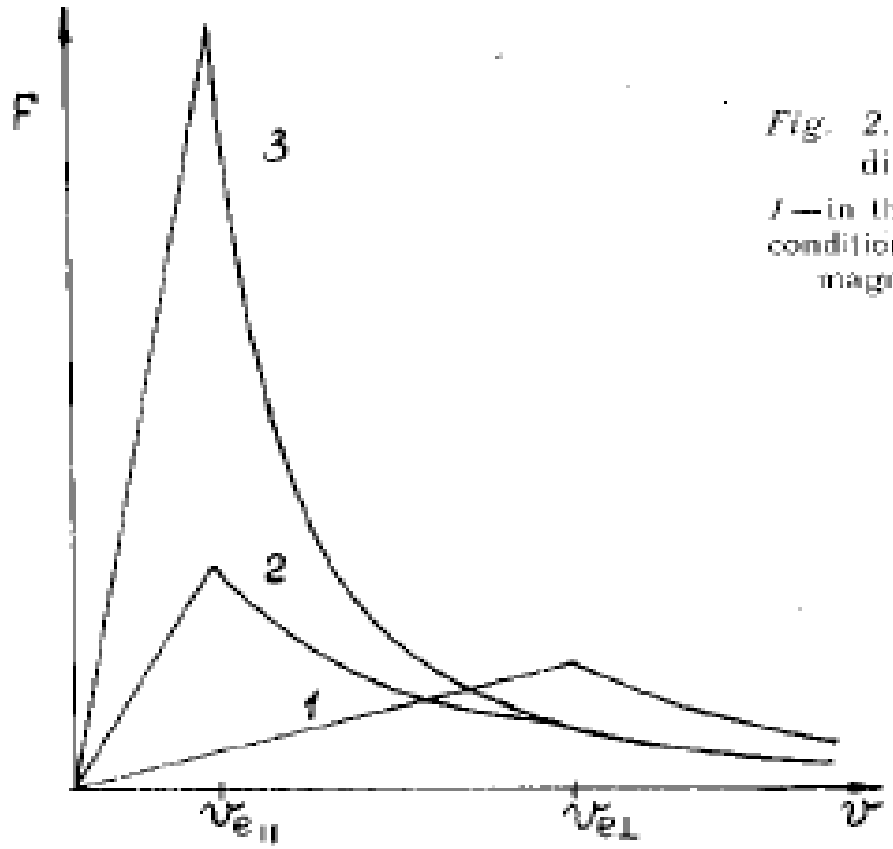


Fig. 2. Behaviour versus friction force at different values of magnetic field.

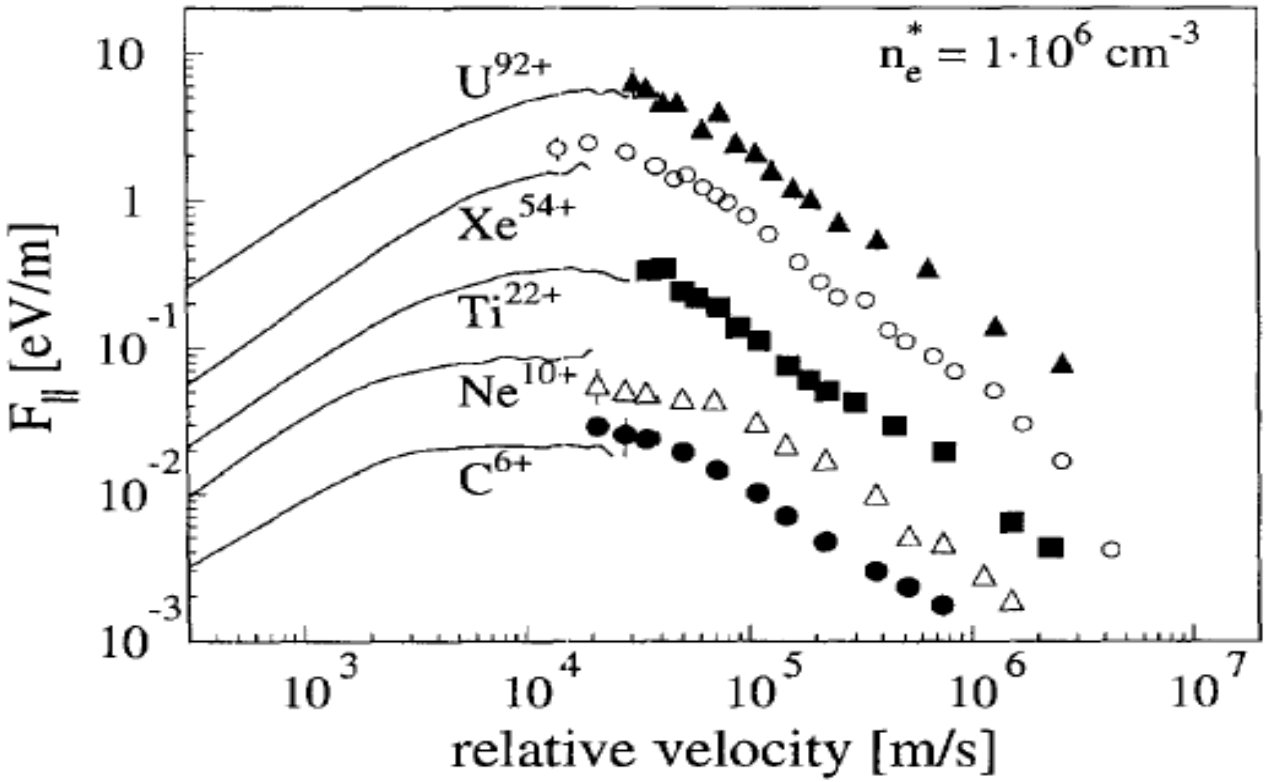
1 — in the absense of magnetic field; *2* — under the condition of partial magnetization; *3* — complete magnetization of transverse electron motion.

Some study topics

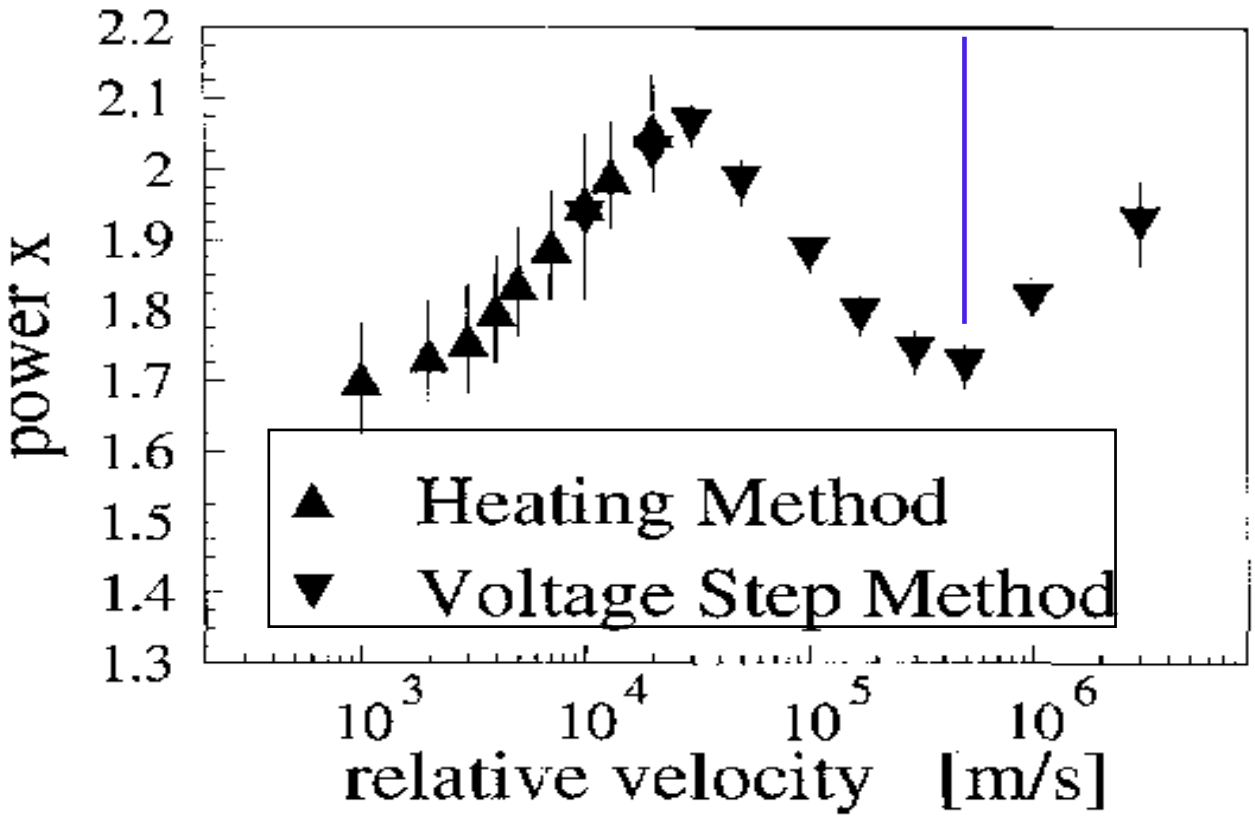
- **INITIAL study topics:**

1. **Find most realistic Cooling force formula for RHIC parameters. Vorpal results seems to help – if necessary, friction coefficients will be taken from Vorpal directly, as pre-calculated Table**
2. **Need various experiments to test parameters relevant for e-cooling at RHIC – high transverse and longitudinal velocities of electrons, Z dependence for our velocity range, energy dependence, dependence on magnetic field strength and errors, etc.**
3. **Find and take most relevant representation of IBS.**
4. **Study detailed IBS vs rms rates in combination with cooling, experimentally.**
5. **Study various cooler parameters: strength and errors of magnetic field, etc.**

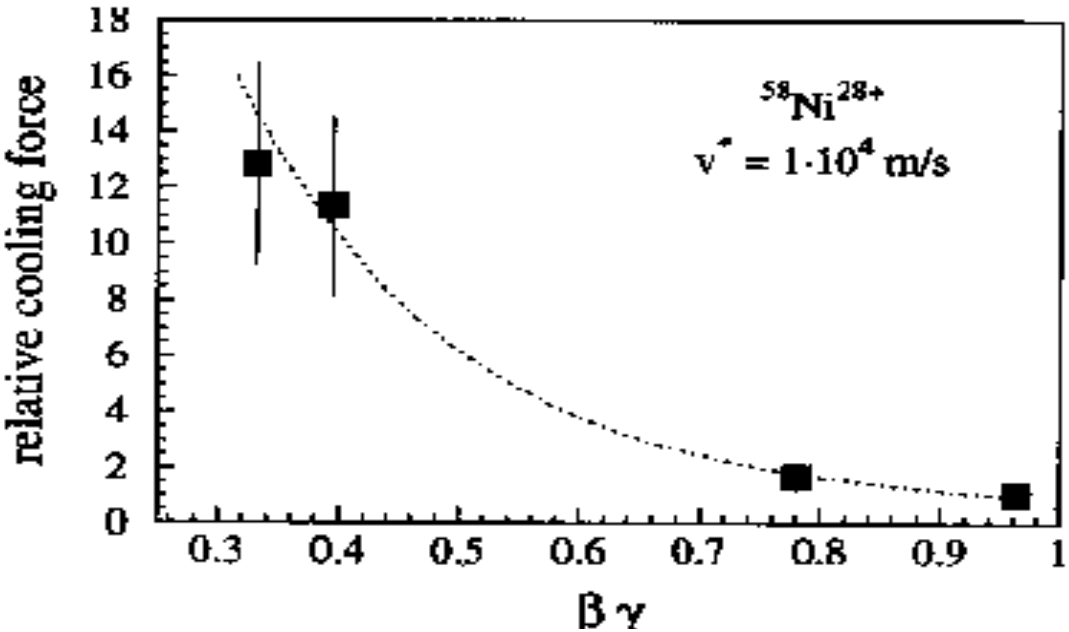
ESR data - 1997



Power of Z –ESR- 1997



ESR-1997 – dependence on energy



beam energy. An average angle θ between the ion trajectory and the electron beam axis will lead to a transverse velocity in the comoving frame of $u_\perp^{ad} = \gamma\beta c\theta$. This will reduce the efficiency of magnetic cooling for higher beam energies for a given θ.

CRYRING – dependence on V_e_transverse – example of non-magnetic case (very low field in cooling solenoid)